Forward Buying of Non-Commodity Consumer Goods

by

Jeffrey Wayne Kight
B.B.A., Neeley School of Business, Texas Christian University, 1998
M.B.A, McDonough School of Business, Georgetown University, 2005

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Signature of Author..
Engineering Systems Division
June 1, 2007

Certified by ....
Dr. Chris Caplice
Executive Director, Master of Engineering in Logistics Program
Thesis Supervisor

Accepted by ....
Yosef Sheffi
Professor, Engineering Systems Division
Professor, Civil and Environmental Engineering Department
Director, MIT Center for Transportation and Logistics

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ABSTRACT

This thesis examines the feasibility of commodity-like forward and futures markets in non-commodity consumer goods. Benefits of information gleaned from the sale of products for future delivery are examined, as well as the market for wine futures, which serves as an example of a non-commodity futures market. Analysis is conducted by controlled experiments in a system dynamics model that simulates the bullwhip effect.

Thesis Advisor: Dr. Chris Caplice

Title: Executive Director, Master of Engineering in Logistics Program

AUTHOR'S NOTE

The following paper represents my thoughts on derivatives and how they may possibly fit into a supply chain context. The transfer of risk outside the world of finance and insurance is in its infancy, and hopefully this thesis will help stimulate ideas for new supply chain designs, distribution models, and risk disaggregation in business.

I would like to thank my parents, Rufus and Susan Kight, for their support and encouragement, without which I would not be able to take risks of my own.

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1 Introduction

1.1 Information Flow in the Supply Chain

When analyzing a supply chain, managers typically concentrate on optimizing inventory levels and product flows as they move downstream. A more sophisticated analysis will attempt to understand the information flowing upstream. Vendor-managed inventory (VMI), for example, helps information flow unimpeded to a particular supplier, thus reducing the errors inherent in basing forecasts on customer orders. In some cases, upstream tiers of the supply chain rely on real-time data that reflects actual order information of their customer's customers. In a completely integrated supply chain, suppliers of raw materials may have perfect information about retailers' orders many echelons below, enabling them to forecast more accurately. At the retail level, forecasting is more difficult. A conventional retailer of consumer products depends exclusively on data from the past to make inferences about the future. Depending on the product, the diversification and scale of its customer base, and the sophistication of its forecasts, errors in future inferences of demand can be volatile.

1.2 Information Flow in Commodity Markets

In commodity markets, suppliers of goods can gauge demand through futures contracts. Customers buy corn, wheat, pork bellies, and other commodities today for delivery at a pre-determined future date. Futures trade on open markets, reflecting a universal market prediction of the future balance between supply and demand. Suppliers of commodity goods have a market in which to sell future production, hedging their own risk of price fluctuations. Thus, both customers and suppliers can lock in future pricing by buying or selling futures, respectively. Summarily, futures markets provide a mechanism to transfer the risk of price fluctuations from seller to buyer, in exchange for a discount to the "spot price," or the price for purchasing the same commodity today. Hedging price fluctuations relegates both the buying and the selling party to a fixed future price, so participants forego the possibility of beneficial price movements as well.

1.3 Information Flow in Non-Commodity Markets

In most non-commodity markets for consumer items, retailers do not have an option of locking in future customer demand. Retailers must find the balance between their cost of shortage and their cost of surplus, and order accordingly. Conversely, consumers do not have the ability to benefit from telling retailers what they are going to want in the future. They may have information about some future need, or may be willing to speculate on their own future demand. The consumer may have a better ability to predict his demand than a retailer, especially in extraordinary circumstances that are only predictable by the consumer. This thesis will explore the potential benefits of a system for forward buying in non-commodity items. It will address the benefits of transferring demand risk from the retailer to the consumer, and attempt to show industries and product categories that may benefit from a system that provides a consumer discount for a "pre-order."

1.4 Organization of Thesis

Principally, this thesis will attempt to answer why companies generally do not give discounts for information about consumers' future demand, and what benefits, if any, are foregone in the absence of forward exchange. Specifically, this thesis is trying to answer the following questions:

- Why do winemakers offer futures contracts?
- Would forward and future contracts and markets add significant value to general, non-commodity consumer products?
- Why are there conventionally no discounts for customers who order products in advance in consumer markets?
- Is it feasible and value-added for companies to offer time-to-delivery discounts?
- Would forward contract markets for non-commodity goods help companies mitigate risk and reduce forecasting errors?

Section Two will outline definitions of forward and futures contracts, and define what may be considered forwards and futures in non-commodity retail markets. It will provide examples of current forward-buying practices in upper tiers of supply chains (business to business), address where retail forward buying currently occurs, and offer a theoretical example of how a retail forward market might work in a typical supply chain for consumer goods. Section Three will highlight the wine industry as the best example of retail, non-commodity forward contracts, and provide a case study for wine futures valuation. Section Four will use a System Dynamics model to simulate different scenarios of conventional buying, forward buying, and the implementation of forward buying in a generic supply chain for non-commodity consumer goods. Section Five will address the findings of both models, and draw conclusions from the research and analysis. It will also address why forward markets for consumer goods largely do not exist, and why supply chains are not set up for this type of discounting for pre-orders.

2 Background

In the context of supply chain management, "forward buying" is defined as purchasing products for immediate delivery that are not yet needed. According to Taylor (2004), forward buying is the act of pre-ordering supplies "before they are needed in order to take advantage of favorable prices." This kind of forward buying can occur because of normal price fluctuations in the market or supplier promotions, and results in an increase in the volatility of ordering throughout the supply chain. He goes on to say that forward buying is a form of "hoarding," and, "can have particularly nasty effects on demand because it contains a positive feedback loop: Hoarding increases scarcity, which further increases hoarding, and so on. In some situations, such as chip shortages in the electronics industry, this self-amplification can escalate a relatively minor shortfall into a worldwide crisis."

This thesis is not an examination of "forward buying" as defined above. The term "forward buying" is examined in the context of definitions in financial markets, which means ordering today at an agreed-upon price for *delivery in the future*. Furthermore, in this thesis, the intent of a buyer engaging in "forward buying" is to project information upstream about future demand, or shifting the risk of future demand from the supplier to the buyer. Therefore, instead of increasing supply chain volatility, this thesis is examining ways to decrease it.

2.1 Definitions

Over the course of the paper, "forwards" and "futures" in the supply chain context will be used interchangeably. Commodity and financial markets have a precise definition of these terms, but none are directly applicable to this topic. The context in which these terms are used in this thesis are a slight variation from the conventional definitions in these markets, since we are not dealing with commodities and financial securities. For example, a purchase made by mail-order for delivery in three days is not called or considered to be a "forward contract," in conventional terms, but it does share the same exact characteristics, with the exception of the underlying product being branded instead of being a commodity. Similarly, a doctor's appointment, or a ticket to a concert or purchased months in advance is not deemed a forward in conventional vernacular.

2.2 Definition of a Futures Contract

According to Brealey & Myers (2003), commodity futures are the oldest form of actively traded derivatives in the world, and were "originally developed for agricultural and other commodities." In 1972, however, financial futures were invented and quickly surpassed the volume of commodity futures. A futures contract is an agreement between a buyer and seller, where a buyer agrees to purchase a product or financial security for a predetermined price at a given point in the future. Commodity futures are traded on futures exchanges, such as the Chicago Board of Trade (CBT), and the Chicago Mercantile Exchange (CME). In futures markets, the price is fixed on the day a contract is purchased or sold, but payment is not made until the future. In order to avoid credit risk or default problems, the buyer of a contract is required to post "margin[1]" in the form of cash or some other liquid instrument.

2.3 Definition of a Forward Contract

If the standardized terms of a futures contract do not suit a particular situation, buyers and sellers can enter into a forward contract. According to Brealey & Myers (2003), forward contracts "are simply tailor-made futures contracts" that are entered into privately between two parties. For example,

> "...suppose that you know that at the end of six months you are going to need a three-month loan. You worry that interest rates will rise over the six-month period. You can lock in the interest rate on that loan by buying a *forward rate agreement (FRA)* from a bank. For example, the bank might offer to sell you a six-month forward rate agreement on three-month LIBOR at 7 percent. If at the end of six months the three-month LIBOR rate is greater than 7 percent, the bank will pay you the difference; if three-month LIBOR is less than 7 percent, you pay the bank the difference." (Brealey & Myers, 2003)

[1] Margin is a fraction of the total estimated settlement price. Rules for the amount of margin required is stipulated by regulatory agencies in the United States.

Summarily, a futures contract is essentially the same as a forward contract, with the exception that it is standardized and tradable. Forward contracts are tailor-made to fit a situation between a specific buyer and seller, and are not standardized (i.e. it may be that only one exists, so it cannot be exchange-traded). Generally, futures and forwards in commodity and financial markets are traded based on products that have perfect price transparency. Interest rates, barley, corn, oats, and wheat all have accessable, real-time prices. A forward contract, such as in the previous interest rate example from Brealey & Myers (2003), typically has customized properties with respect to dates, but the underlying product (the London Interbank Offered Rate, a common interest rate benchmark) is still a known index. In contrast, when examining non-commodity forwards/futures, there may be several characteristics of the contracts that are estimated or unknown, such as the best current price for the product, or the exact delivery date.

2.4 Definitions in Context

If the definition of forward contracts is limited to individually customized agreements for future delivery, then it may be extrapolated to a number of situations not conventionally labeled as forward purchases. While the specific vernacular in the financial industry constrains the definition to commodities and other financial assets, the principle of the definition can relate to several other transactions consumers make every day.

For example, a consumer agreeing to purchase an unfinished house six months from now for $300,000 will enter into a forward contract with the builder. Internet retailers sell products for future delivery as well, constituting a forward contract in the spirit of the definition. Thus, this thesis will refer to any consumer purchase not immediately "consumed" or physically delivered at the point of sale as a "forward."

For purposes of this thesis, a "commodity" is defined as any good that has an active, liquid, and generally accepted futures market on any financial exchange. According to Webster's New World Dictionary (1976), commodities are "basic items or staple products, as of agriculture." It could be argued, however, that a commodity is any product that is readily available from several suppliers, each of which provides a buyer with a similar value proposition. In this thesis, a commodity will refer to its conventional definition. Wine, for example, will not be considered a commodity just because it comes from one producer. Even though one bottle of a specific type in a specific vintage could be considered a commodity, it is not in the context of this thesis. Other branded products, such as tires, textiles, or consumer electronics will also not be considered commodities, simply because the same products are supplied by several retailers and wholesalers. This will be an important distinction, since the term "commodity" has several broader definitions. Webster's Dictionary (1976) also defines a commodity as "anything bought or sold; any article of commerce," and, "any useful thing."

2.5 Bullwhip Effect

As a benchmark for determining the value of forwards and futures in the supply chain, this thesis will examine the extent to which the bullwhip effect is reduced.

According to Hau, Padmanabhan, and Whang (1997), the bullwhip effect (or demand amplification) is an increase in the variability up the supply chain, due to hoarding, demand forecast updating, order batching, and rationing/shortage gaming.

Figure 2-5: Increasing Order Rate Variability Up the Supply Chain

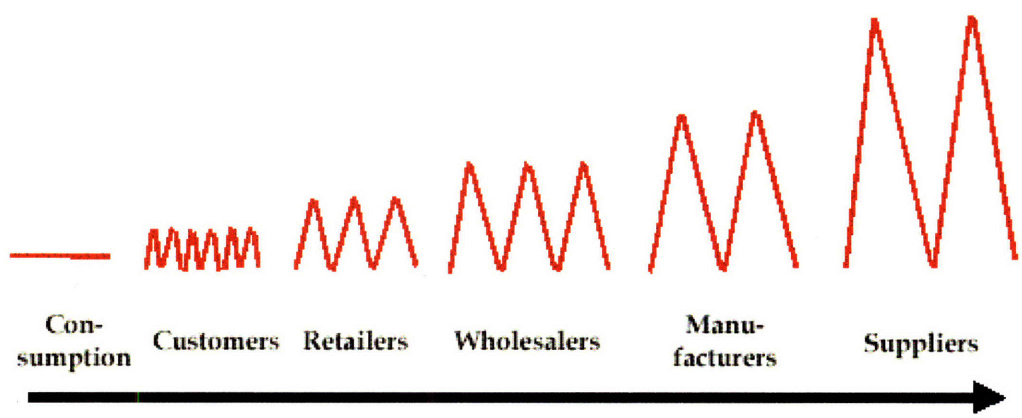


Image: http://web.rollins.edu/~tlairson/ecom/com515h.html

Hoarding is more conventionally called "forward buying" in a supply chain context, but should not be confused with the definition of forwards in this thesis. Again, this concept refers to stockpiling goods to take advantage of a promotion or cyclical price decline in prices. It does not mean forward buying for future delivery.

Demand forecast updating refers to the adjustment made to inventory levels caused by backwards-looking indicators of demand. If a store typically sells 10 units of a particular product per week, and then suddenly sells 15, it may order 25 units; 15 for replenishment of inventory, 5 for a perceived perpetual increase in demand, and 5 for increase in safety stock due to its uncertainty. Thus, the order volatility is magnified.

Order batching is the aggregation of orders for the purpose of minimizing total order cost for a buyer. Buyers throughout the supply chain may have one-time order costs, creating a situation where buying in certain quantities minimizes total costs.

Rationing/shortage gaming refers to the positive feedback loop of ordering more in a perceived shortage. When there is a shortage, supply chain participants increase their orders to mitigate risk, and the upstream shortage is thus exacerbated.

2.6 Motivation and Expected Results

Forecasting and inventory management may be improved by simply creating a conduit for gathering consumer information about future demand. If this consumer information is valuable to a manufacturer, wholesaler, or any other supplier, it may be captured by offering reasonable discounts for forward buying. The idea of providing a mechanism to order forward at a discount cannot have negative value for consumers by definition; it is a real option for consumers, and they can choose not to order products this way. (That is, a mechanism that provides consumers with an option to do something different cannot make them worse-off.) Also, managing risk of shortage and surplus in the supply chain is extremely difficult, and companies may want to mitigate this risk. For example, imagine if United Airlines (UAL) auctioned its seats one year in advance in an IPO format. United Airlines would state its capacity and planned routes for the year, and sell the entire capacity all at once to an intermediary ("underwriter"). The underwriter, before purchasing UAL's full capacity, would solicit buyers for each individual ticket. Some buyers would purchase tickets in bulk, with the intent of selling them individually in the future. Speculators, just as in financial equity markets, may enter the market and trade the capacity, and end-users of the airline would pay prices at market equilibrium (or the balance between demand and supply). Those willing to take the risk months in advance would have the ability to speculate on the future demand of the seats, inflation, the sustainability of the airline, and the airline's reputation. The airline would receive this cash flow on day one, and monetize its future revenue stream in advance. It would have more visibility and the ability to change its capacity and cancel planned flights well before customers bought tickets. In effect, UAL would diffuse the risk of future demand to the underwriter.

2.7 Forward Buying Benefits in Capital Markets

In capital markets, risk transfer is much more common and more easily executed. Firms that originate financial products, such as mortgage originators, also have lag times in the sales cycle from the "purchase of raw goods" to final delivery to the customer. Banks, for example, may originate mortgages to individuals (raw goods) with the intent of bundling them together (manufacturing) and selling them at a higher price (upon securitization and final delivery to investors). These securitizations pose a time risk, since interest rates may rise between the time of origination and the time of final sale to investors. Capital markets, however, offer these originators the option of purchasing hedges to interest rate movements, whose prices are market driven and based on the volatility of demand for capital at the time of purchase. Information about future expectations is completely transparent through price discovery of various hedging vehicles (such as interest rate futures).

There is a distinct information asymmetry, however, in the demand for non-commodity consumer goods. Downstream participants in the supply chain may have a better understanding of their future demand than do upstream participants. A car owner, for example, knows that he will need new tires sometime in the next three to four months. He is the most familiar with the cyclical nature of his needs, and it is positioned to make the most accurate determination of future need. The tire retailer, however proficient with information analysis or its ability to acquire data about its customer's ordering habits, is at an information deficit. Thus, the bullwhip effect takes hold, and upstream participants endure radical shifts in demand through information asymmetry, forecasting error, and system oscillation.

2.8 Forward Buying Benefits for Non-Commodity Goods

Volatility of downstream demand strips value from the supply chain as a function of information asymmetry. The effect is wild shifts in production output, and shortages or surpluses of inventory. These shifts manifest themselves in loss of revenue and carrying costs for the manufacturers or wholesalers. Other costs can be attributed to the existence of wholesalers themselves, since manufacturers are not in the business of warehousing goods. Imagine a systemic paradigm shift to forward markets for all kinds of goods, from car tires purchased by consumers to jet aircraft manufactured by Boeing. Speculators, end users of goods, or wealth managers can assume the risk of demand shortages and surpluses simply by purchasing the future delivery for goods at a discount to their expected value in the future.

A buyer of a forward contract for tires, for example, could enter into a contract for payment and delivery of a set of tires for his car six months in advance for a 10% discount to fair market price for delivery today. At expiration of a forward contract, the counter-parties would be obligated to perform; the buyer would pay 90% of the going rate for delivery today, and the manufacturer would be obligated to ship the set of tires in six months. As traded over the open market, the contract's discount would erode to 0% over the course of six months, and the contract owner would have the right to sell the contract anytime to a buyer in desperate need of the same tires immediately (perhaps at a premium over present-day pricing, as determined by the supply and demand of purchasing rights). The original discount would be determined by the tire supplier, and would be a function of the cost savings realized through the certainty that the sale will take place.

2.9 Value Proposition of Forward Buying for Non-Commodity Goods

In a perfect market that facilitated such an exchange, forecasting would become the burden of downstream participants. I hypothesize that an extreme case would invert the bullwhip effect, and the total system-wide value proposition would be equal to the difference between the ability of downstream participants (the end-users) to forecast demand and the ability of upstream participants (the manufacturers) to forecast demand. Commodities are traded on this premise, but it may be possible to trade branded products similarly. The amount of the discount offered by a manufacturer relative to the length of time of a contract would be a function of its variability of demand, its cost of shortage or surplus, and its capacity. Contracts could be sold years in advance as well to finance the purchase of new manufacturing capacity, while reducing the firm's cost of capital through demand-based risk mitigation.

The effect would be that manufacturers may only have to sell product in advance. Each manufacturer may offer a virtual market for traders of the rights to buy and sell upcoming shipments, but the firm's only burden would be the sale of future production (presumably farther out than the time it takes to produce the finished good). A firm may wish to take on demand risk, and purchase its own rights of delivery for sale at a future date. It would, however, be able to diversify its risk of demand variability at will.

2.10 Conventional Supply Chain Discounts/Price Discrimination

The bullwhip effect in supply chains poses a formidable forecasting challenge for manufacturers and upstream wholesalers. Specifically, those firms close to the source of manufacture are more burdened with the accurate prediction of future demand under disproportionate uncertainty. End-users, for example, have little incentive for forecasting or communicating their known future demand. Manufacturing firms are also conventionally constrained to second and third-degree price discrimination[2], and have a difficult time charging premiums in the short-term to take advantage of supply shortages (vis-à-vis specialty products sold via online auction). Most price discrimination takes the form of discounts for volume purchases, but rarely takes the form of discounts for time lags in delivery. Furthermore, manufacturing firms and upstream suppliers are constrained to assuming most, if not all, risk associated with profit loss in supply shortages, or inventory costs in the case of supply surpluses.

2.11 B2B Examples—Strategic Forward Buying

Forward buying occurs everywhere else in supply chains; business-to-business purchases conventionally incur lead times due to production and/or long transit times. Sometimes, however, forward buying beyond shipping lead times is not affected exclusively for a discount. Several high-tech companies have begun to enter into long-term purchase agreements for the strategic acquisition of materials. Apple computer has entered into contracts valued over $1 billion to lock up flash memory capacity in the industry

[2] Second degree price discrimination relates to discounts for volume purchases. Third degree price discrimination relates to discounts by geography or customer segment; for example, discounts for senior citizens.

(Hillman, 2007). Its intention is to strategically limit the amount of flash memory available to competitors so they cannot introduce competing products over the term of the contracts (which is undisclosed). Hewlitt-Packard has also entered into long-term buying contracts to avoid supplier bankruptcies, as well as to secure larger volume discounts (Hillman, 2007). Intel has the most advanced forward contracts in the industry, buying general capacity of its suppliers forward, with agreed-upon times for specific specifications and designs of the products closer to the delivery date. (Hillman, 2007)

2.12 B2C Examples—Forward Buying for Discounts and Scheduling

Consumers buy products forward every day from internet retailers. A book purchased at Amazon.com may arrive the next day, two days later, or five to seven days later. At the point of checkout, a consumer must decide if delivery overnight justifies the premium over a slower shipping speed. These decisions are common with web or mail-order purchases, but the options are limited. What if the customer knows he will need a book one month from now? Currently, his best option at Amazon would be to wait until seven days before he needs it to place an order. Would this information be valuable to Amazon one month in advance? Would Amazon be willing to offer a discounted price for this information?[3] Using the definition of forward contracts above, consumers commonly engage in forward contracts. Forward contracts in consumer goods can be commonly categorized as products or services. Some examples are:

[3] Amazon does sell products forward months in advance at a slight discount if the products have not yet been released.

Product/Service	Example	Explanation
Products	Homes	Typically, a consumer enters into a purchase contract for a fixed price with a builder for "delivery" at some point in the future.
	Web/Mail Order Purchases	There is at least a lead time for delivery when consumers order products to arrive on their doorstep. Frequently, products bought forward by consumers include mail order items, such as books, DVDs, and clothing. These items are typically held in stock by a retailer, and the duration of the forward contract is a function of shipping time. A consumer usually has several options of payment vs. time-to-delivery, but the variance is only in days, not weeks or months.
	Large-Ticket, Customizable Items.	Less frequently, consumers buy products forward from manufacturers who have not yet produced the product. For example, consumers purchase automobiles, yachts, furniture, and other large-ticket items because they want the products customized, or the exact product they want is not available in stock. When purchasing a car, a consumer has the choice of buying off the lot, or custom ordering the exact color and options combination he wants. For him, the extra time to delivery is not as important as getting exactly what he wants. Yacht and furniture manufacturers conventionally do not warehouse vast inventories of products. In these markets, it is necessary to buy forward, which is usually a consumer's only option. Substitutes may be available, however, in the form of used products bought second-hand. Homebuilders, for example, will sell new homes well before they are ready to "deliver," and consumers are willing to wait. This gives consumers the ability to customize the home how they wish, offering them flexibility in options.
Services	Doctor visits, sporting events, and airline travel.	These services are sold forward mainly for capacity planning purposes, as well as for convenience to the provider and the consumer.

None of these forward contracts are tradable, and there are no explicit or implicit discounts for buying forward. Consequent to mail-order items, however, there is evidence that customers are willing to pay a *premium* for products when they want them immediately. In some cases, such as customized automobiles, a customer may be charged a de facto premium for buying forward, since the dealer is willing to discount inventory he already has on his lot.

In summary, forward and futures contracts are agreements made between a buyer and a seller where the buyer agrees to purchase a product from a seller for a predetermined price on a specific future date. Financial and commodity markets benefit from supply and demand transparencies through futures, and I hypothesize that contracts such as these can push information upstream in a manner that is quantifiably beneficial to the supply chain. Furthermore, the quantifiable benefit can be shared with consumers of non-commodity products in the form of discounts. Forwards and futures may create transparencies that reduce the bullwhip effect upstream, shrinking costs associated with forecasting errors. Forward purchasing already occurs in a business to business context, as demonstrated in examples of Apple, Hewlitt-Packard, and Intel. Consumers demonstrate willingness to receive a discount for longer shipping times, and may also be willing to accept longer delays for larger discounts.

3 Case Study: Wine Futures

One non-commodity, consumer product whose futures are commonly traded is wine. The following insights from executives in the wine industry highlight reasons the wine futures market exists, how it began, and why its use is mostly limited to one region of the world. The case study below will point out the mutual advantage of discounting future wine delivery, and illustrate how a basic futures contract can be valued. Furthermore, it will point out the risks for both the winery as well as the consumer in entering such a contract.

3.1 The Wine Supply Chain and the Uses of Futures

"Wine futures" is an accepted term in the wine industry, but since the product is not a commodity the agreement is between two parties with no clearinghouse of exchange, it is technically a forward contract.

3.1.1 Real Futures Markets for Wine

According to Spahni of the Economic Research and Consultancy for Wine (Forbes.com, 2007), the Euronext exchange developed the first actual wine futures market in September, 2001, under the name "Winefex Bordeaux." The market was designed to allow Bordeaux producers to reduce their systematic exposure to the market of fine wines, with speculators (investors) providing liquidity. These futures are pure derivatives based on a published index of 140 well-known labels. Commonly, however, the term "wine futures" refers to the forward contracts sold to brokers and retail customers for actual delivery.

3.1.2 Reasons for Futures in Bordeaux

Wine futures are almost completely exclusive to Bordeaux production in France. Once grapes are harvested and processed into wine, producers store it in barrels for about two years for maturation before bottling. Between the time wine is barreled and the time it is bottled, Bordeaux producers sell the wine forward to wholesalers or brokers through "Negotiants," or domestic intermediaries. In the middle to later half of the 20th century, wine producers used these futures to mitigate quality risk of the wine. According to Jeff Smith (Interview, April 4, 2007), a California-based wine broker, wine producers have experienced a leap forward in technology over the past 20 years. "Wineries are like chemistry labs now. Quality is tightly controlled, and the average Bordeaux has only a 5-8 point variance over the last 10 years. These days, it is very rare for a winery to lose control, and the mitigation of quality risk is no longer a primary reason for selling futures." He adds that Bordeaux producers typically use futures as a financing vehicle, the same way an owner of debt obligations, such as a mortgage company, uses securitizations. Futures are a way to receive cash immediately for a product that will not be delivered for up to two years. Robert Parker, a world-renown wine taster, "literally makes or breaks the market for each wine and its eventual market by tasting and rating it from the barrel." Thus, the quality of the wine is determined before it is bottled, and futures are a way of receiving an advance on revenue. According to the Smith, in his opinion, the purpose of futures today only serves the purpose of advance financing.

3.1.3 California Subscriptions

California wineries operate differently. According to Frank Melis (Interview, April 11, 2007), President of Golden Gate Wine Cellars in San Francisco, California, there are a handful of wineries that offer futures, but not many. He agrees that futures only serve the purpose of "hav[ing] the revenue earlier," but adds that it may be a way to drive up retail prices once they are released. Since customers and retailers assume that futures contracts include inherent discounts, the market price is likely to rise immediately when the bottled wine enters the market. The main method of selling California wine is through a subscription service. Retail customers and brokers sign up for subscriptions to purchase the wine once it is bottled. The price is determined at the point of bottling, and there is typically a long waiting list to subscribe to high-end wines. He further states that the subscription service reduces operational complexities for wineries by avoiding wholesale transactions. "This way,...[wineries] do not need to deal with selling wine wholesale [which] keeps their overhead down. They require less staff in the office to process in and outgoing invoices that would come in on a day-to-day basis if a retailer or restaurant orders one case of wine today, one tomorrow, etc. With subscriptions, wineries can fulfill a massive amount of orders all at once when they allocate wine to subscription holders. Usually, though, the wine will fall back to 10-20% below its original subscription price in retail stores after two or three months, and customers are unaware that they are paying an initial premium. I think that the subscription business exists because the wineries are a little greedy and they don't want retailers to share their profits."

3.2 Wine Futures Valuation

If wine futures are just a method of financing for a winery, then the discount they offer should simply be a function of a winery's cost of capital, and can be valued similar to a loan secured by future profits. The winery, having accepted funds up front, has relatively no risk with respect to the final delivery of the contract. If they do not produce wine, it would be considered the same as a defaulted loan, and consumers would presumably not buy its futures contracts going forward. Unless the wine is legally sold to a separate entity, the way loans are sold to Special Purpose Entities[4] (SPEs) in securitizations, the winery may be financially liable through a civil suit. Let's assume, however, that winery is not directly liable, and risk of delivery of the wine is completely transferred to the buyer of the futures contract.

After the winery has transferred its risk, the consumer bears all of the following risks:

- Systematic price risk. Will all wine cost less in the future?
- Non-systematic price risk. Will the wine be the expected quality based on barrel-tasting ratings?
- Production risk. Will the wine actually be delivered?

[4] SPEs are bankruptcy-remote, off-balance-sheet entities that secure the seller of the loans from legal or financial recourse if the loans do not perform. If a winery operated in this fashion, it would sell its inventory to an SPE, the SPE would sell the inventory to futures buyers, and the SPE would then use those funds to buy the inventory from the winery (all occurring simultaneously).

- Default risk. If the wine cannot be delivered, will the winery pay back principal and interest to secure its reputation?
- Foreign exchange risk. If the exchange is international, will the dollar appreciate against the foreign currency, causing the price to drop between the purchase of the contract and delivery.

In order to take these risks, an investor will need to be compensated by way of a discount.

3.2.1 Case Example of Valuation

According to Brealey & Myers (2003), a commodity futures contract (F_c) is valued by using the following equation:

$$\frac{F_c}{(1+r_f)^t} = \text{Spot Price} + \text{PV(storage costs)} - \text{PV(convenience yield)}$$

Where:

F_c = futures contract value (commodity)

r_f = risk-free rate of return

t = time until delivery

Also according to Brealey & Myers (2003), a financial futures contract (F_f) is valued by using the following equation:

$$\frac{F_f}{(1+r_f)^t} = \text{Spot Price} - \text{PV(dividends and interest payments foregone)}$$

Where:

F_f = futures contract value (financial)

In commodity futures, the present value of storage costs represents how much it would cost to store the commodity for the length of the futures contract, and the present value of the convenience yield represents how much the flexibility of actually storing the product is worth. For example, if you hold a heating oil futures contract, you have nothing to burn if weather suddenly turns cold.

In a financial futures contract, there is no storage cost, but the convenience yield is replaced by the foregone dividends and interest that would be received if the actual underlying asset was held.

For wine futures, the equation must be modified to reflect a unique situation. The most relevant equation is financial futures, since storage costs and convenience yield are not risks that are transferred. The product (bottled wine) does not yet exist, and is still in the manufacturing process. To illustrate the value of a wine futures contract to both a buyer and a seller, the following adaptations are made:

In both equations, the futures value is discounted by the risk-free rate of return $(1+r_f)^t$, because the actual payment is made upon delivery of the final product. In the case of wine futures, the futures contract is paid for on day one, eliminating the need to discount wine futures (F_w) by the risk-free rate of return, giving us:

F_w = Spot Price – PV(dividends and interest payments foregone)

The closest approximation to the spot price is the estimated value of the wine at delivery, which may fluctuate over time. This "spot price" is not representative of today's price, since the wine cannot be delivered today, and must be discounted by the opportunity cost of capital.

The opportunity cost of capital, according to Brealey & Myers (2003), is "the expected return that is foregone by investing in a project rather than in comparable financial securities," and is sometimes referred to as a "hurdle rate," or simply "cost of capital." In other words, the cost of capital is the required return for an investor to take any particular risk. The weighted average cost of capital, therefore, is a weighted average of a company's required returns with the value of the assets that create those returns. Theoretically, the producer is using both levered and un-levered capital to produce the wine, so his weighted average cost of capital should be used to derive its discount rate. The consumer will use his "weighted average cost of capital" as well, which is a little more difficult to define.

Both the buyer and the seller of the futures contract have a different opportunity cost of capital that is unique to their particular financial situation. A consumer, for example, is restricted to common financial assets, whereas a winery has access to operating investments specific to its business. Furthermore, a buyer may have excess cash, in which case his capital charge for a risk-free asset would be a common deposit instrument, such as a U.S. Treasury bill or a money market fund. A winery may have a mixed capital structure of equity and debt, thus increasing its expected rate of return.

According to Modigliani and Miller's (MM) Proposition II (Brealey & Myers, 2003), the expected rate of return on the common stock of a levered firm increases in proportion to its debt-equity ratio. Therefore, if the capital structure of a company includes debt, it has a higher expected rate of return than the same entity with zero debt. Simply stated, the more debt a company has, the higher the rates at which it borrows, and the higher its required return on invested capital. Summarily, a company with higher debt places a higher premium on cash, and needs increasingly higher expected returns to justify cash investment.

Consider a buyer with excess cash seeking risk-free investments. He would invest at Treasury, money market rates, or certificate of deposit rates. Depending on its leverage, a company seeking a risk-free investment would pay off debt first, most likely at higher interest rates than the buyer would get. Therefore, the capital charge for companies with debt at rates exceeding a buyer's risk-free deposit rate would be higher.

Due to leverage, a winery may have a different opportunity cost of capital than a consumer. Since the spot price must be replaced by the present value of the expected delivery price, the equation must be modified further:

F_w = PV(expected market price at time of delivery) – PV(dividends and interest payments foregone)

Since the wine is still in the manufacturing process, and there is no benefit of holding it, it does not produce any kind of dividend or interest. From a commodity futures context, it does not have a convenience yield, and since it has yet to be fully produced, we will assume that there is no cost of storage. Therefore, we zero out the second half of the equation representing dividends and interest payments foregone.

F_w = PV(expected market price at time of delivery)

The discount rate for the expected market price at time of delivery must include a risk premium to account for the risks being transferred, plus the corresponding opportunity cost of funds. There is risk inherent to the asset, which has nothing to do with an entity's capital structure. It is simply the required rate of return any investor would demand to assume this specific risk. However, once capital structures become levered, hurdle rates change, and the buyer and the seller of a futures contract may have a different demand for cash. For a buyer of wine futures, we will say that the futures contract for wine ($F_{w(b)}$) is equal to $F_{w(b)} = \frac{EMV_T}{\left(1 + r_{k(b)}\right)^{T-t}}$, and for the seller of a futures contract, we will say that

$F_{w(s)} = \frac{EMV_T}{\left(1 + r_{k(s)}\right)^{T-t}}$, where r_k represents the corresponding cost of capital for the buyer (b) and seller (s). T represents the time of delivery in the contract, and t represents an observed point in time before T for valuation. Also,

EMV = Estimated Market Value

$F_{w(b)}$ = value of forward contract (wine) for the buyer

$F_{w(s)}$ = value of forward contract (wine) for the seller

For simplicity, S_T represents the estimated future spot price at the time of delivery. Using continuously compounding interest, the equation can be written:

$$F_{t,T} = S_T e^{r(t-T)}$$

According to Frank Melis (Interview, April 4, 2007), it is common for wine futures contracts to be priced at a 20% discount to their expected value at delivery one year in advance. Therefore, wineries' implicit cost of capital for the inventory (risk of price movement plus cost of funds) is greater than 20%, since, by selling futures at a 20% discount, they are representing this to be an efficient way to raise capital.

Regardless, futures offer a systemic value proposition if $[r_{k(b)} < r_{k(s)}]$.

Let's say that a consumer uses excess cash to finance the purchase of a wine futures contract, representing a 5% opportunity lost in a money market instrument. He also figures that the total risk he is taking is worth 14%, thus making his total opportunity cost of capital 19%. (The compensation for total risk equals the risk premium for "default," or his compensation for risking loss in his investment, plus the risk-free rate of return.)

Conversely, the producer has realizes the same risk premium of 14%, but the interest rate on its line of credit on which it has an outstanding balance is currently at 7%. Therefore, it is willing to pre-sell future production (credited as unearned revenue and debited as cash on his balance sheet) at a 20% discount or less. Doing so will increase the net present value of its future cash flows, and thus increase the value of the company.

The futures contract is for one case of wine, which Robert Parker estimates will cost between $900 and $1,100 upon bottling in one year. As the wine ages, this figure may fluctuate.

$$F_{t,T} = S_T e^{r(t-T)}$$

$$F_{0,1} = 1000e^{.2(0-1)} = \$818.73$$

Based on the expected value of the wine of $1,000, the producer wins by *selling* futures in excess of $818.73. By *purchasing* the futures contract at $818.73, the consumer is assuming an implied probability of *losing his entire investment* of 14% minus the risk-free rate of return.

As time to delivery approaches zero, the fair market value of the wine will approach S_T, or Parker's original estimate of the wine's value at delivery date. According to Smith, Parker's estimates are typically very accurate and precise. Furthermore, a catastrophic event causing a winery to shut down operations, lose inventory, or enter bankruptcy are extremely uncommon. Assuming there was a zero percent chance of operational failure of the winery, the consumer would be basing his risk premium exclusively on future price fluctuations, both systematic and non-systematic. Even if the future price differences were uniformly distributed between $900 and $1,100, an investor would most likely never demand this much of a premium for risk compensation. Consider the following example:

Case Study Example: Potential Outcomes for Buyer

Description	Value	Explanation/Equation
Expected price in one year	$1,000	Expected market value one year from purchase of contract
Upper Bound potential value	$1,100	Upper bound of uniform distribution
Lower Bound potential value	$900	Lower bound of uniform distribution
Total discount (seller)	20%	Discount rate at which it is beneficial for the seller to sell wine forward
Futures contract price (at seller's discount rate)	$818.73	$=1{,}000e^{0.2(0-1)}$
Worst-case Return (buyer)	9.93%	$=\left(\frac{900-818.73}{818.73}\right)$
Best-case return (buyer)	34.35%	$=\left(\frac{1{,}100-818.73}{818.73}\right)$
Expected return (buyer)	22.14%	$=\left(\frac{1{,}000-818.73}{818.73}\right)$

From a consumer's standpoint, even after his 5% risk-free cost of capital is removed, it is a riskless exchange, assuming he can sell the wine for fair market value upon delivery. Even if the cost of the wine was $900 at the point of delivery, he would still make 4.93% above the risk-free rate. Therefore, a consumer may be willing to accept a smaller discount in this case.

In summary, wineries may be able to raise capital by offering future production at well below their weighted average cost of capital. It is an excellent risk/return proposition for buyers of futures contracts, if their personal opportunity cost of funds is lower, and based on the assumptions above, they should be willing to purchase futures at smaller discounts than are currently offered. In other non-commodity markets, price fluctuations may not be the only risk buyers will be assuming. Product obsolescence, substitute availability, and personal future need for the product may need to be considered. In contrast, the economics of the benefits for sellers may be completely different. Retailers and wholesalers may use forwards strictly for forecasting and planning purposes, and may have a significantly lower cost of capital than consumers. In this case, risk-premiums and risk-free rates of capital may be completely different between buyer and seller, and calculations may prove difficult or arbitrary.

4 Theoretical Benefits in Other Markets

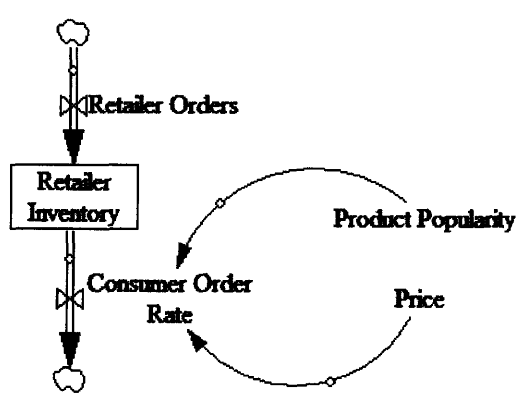
The wine example illustrates two key points; 1) wineries use futures for financing purposes and perceive the benefit as limited to a cheap way of raising capital, and 2) there is a systemic value proposition in forward markets if there is a difference between a buyer's and seller's next best use of cash. To further explore the benefits of forward markets for non-commodity goods, we will look at a generic supply chain for consumer products consisting of four tiers; a manufacturer, a wholesaler, a retailer, and a consumer. Using a System Dynamics model to simulate the bullwhip effect, controlled experiments will be conducted to measure the amplitude of order volatility, and the corresponding cost to forecasting errors.

4.1 System Dynamics Modeling

According to Sterman (2000), "System Dynamics is a perspective and set of conceptual tools that enable us to understand the structure and dynamics of complex systems . . . It is also a rigorous modeling method that enables us to build formal computer simulations of complex systems and use them to design more effective policies and organizations."

System dynamics (SD) modeling helps to understand the relationship between stocks, flows, and other variables over the course of time. It is used to design and simulate systems, using an intuitive graphical interface. SD modeling is unique because a user can easily see dependent relationships between variables in a visual diagram. Whereas an Excel model must be audited to find variable dependencies, and SD model clearly shows them in a simple, graphical chart. Stocks, or points of aggregation, are represented by boxes. The flows of the stocks are represented by pipes and valves, pictured below. Clouds represent boundaries of the model, where units of stock can enter or exit the system freely. Arrows show causal influences; for example, the consumer order rate in 4-1 depends on product popularity and price.

Figure 4-1: Sample System Dynamics Model

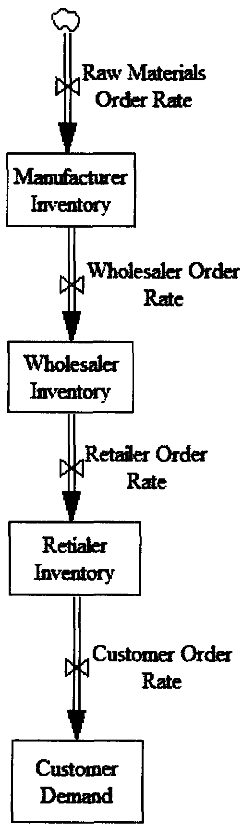


4.2 Introduction to System Dynamics Model

Forward buying in a non-commodity, consumer supply chain will send consumer information upstream faster, allowing for cycle times and delivery lags to run their course before the customer expects to receive the product. In order to test the effect on variability in the supply chain through different levels of forward buying, a simulation of a simple supply chain was designed using Vensim, a System Dynamics modeling software application.

The supply chain being modeled is a generic supply chain which includes four tiers; a manufacturer, a wholesaler, a retailer, and customers. Each of these tiers manages its own inventory and sets its own safety stock levels. For simplicity, each tier orders from its respective suppliers once per week, and after making an order, items take one week to arrive. (Figure 4-2 shows the product flow section of the system dynamics model used to capture data for the analysis. The full system dynamics model is shown in the Appendix.)

Figure 4-2: Partial Model for Bullwhip Simulation



Customers have a decision to order out of retailer inventory ("conventional ordering"), or purchase a unit three weeks forward ("forward ordering"). There are two customer inputs; a conventional order flow, and forward order flow, over the 100 week period of time for which the model runs.

The model is broken into steps, in which the manufacturer, wholesaler, and retailer all have the same forecasting and ordering rules.

4.3 System Dynamics Model: Conventional Ordering

Retailer

Step One:

The conventional customer orders go to the retailer. The retailer tallies all of the orders for the week, supplying the customer demand out of inventory immediately.

Step Two:

The retailer develops a forecast based on two inputs. The first input is orders from the previous week. The retailer assumes that last week's demand will be next week's demand. The second input is a 10% overcompensation for the difference between last week's orders and the orders two weeks ago. Let's say that orders in week 1 are 30, and orders in week 2 are 40. The retailer's forecast will be 41 for the next week (40 for the previous week, plus 10% of the difference between 30 and 40).

Step Three:

The retailer states its *desired order level.* The *desired order level* is the amount it will take to replenish inventory up to its safety stock level, plus the current forecast, plus any backordered items that could not be fulfilled due to wholesaler inventory shortages.

Step Four:

The order is then either accepted or denied by the wholesaler based on his inventory levels. The final *retailer order rate* is the minimum of the wholesaler's inventory or the *desired order rate* as calculated in Step Three. That is, the wholesaler will fulfill as much of the *desired order rate* as it can if it cannot fulfill the entire amount.

Wholesaler

Step One:

Retailer orders (from the *retailer order rate*) go to the wholesaler. The wholesaler tallies all of the orders for the week, supplying the retailer demand out of inventory. immediately.

Step Two:

The wholesaler sees the retailer's desired order rate, and forecasts the same way. It takes the retailer's last order, plus 10% of the difference from last week's order and the order two weeks ago.

Step Three:

The wholesaler states its *desired order level.* The *desired order level* is the amount it will take to replenish inventory up to its safety stock level, plus the current forecast, plus any backordered items that could not be fulfilled due to manufacturer inventory shortages.

Step Four:

The order is then either accepted or denied by the manufacturer based on his inventory levels. The final *wholesaler order rate* is the minimum of the manufacturer's inventory or the *desired order rate* as calculated in Step Three. That is, the manufacturer will fulfill as much of the *desired order rate* as it can if it cannot fulfill the entire amount.

Manufacturer

Step One:

Wholesaler orders (from the *wholesaler order rate*) go to the manufacturer. The manufacturer tallies all of the orders for the week, supplying the wholesaler demand out of inventory immediately.

Step Two:

The manufacturer sees the wholesaler's *desired order rate*, and forecasts the same way. It takes the retailer's last order, plus 10% of the difference from last week's order and the order two weeks ago.

Step Three:

The manufacturer states its *desired order level.* The desired order level is the amount it will take to replenish inventory up to its safety stock level, plus the current forecast. There are no backorders at the manufacturer level. It is assumed that the manufacturer always gets what it orders.

4.4 System Dynamics Model: Forward Ordering

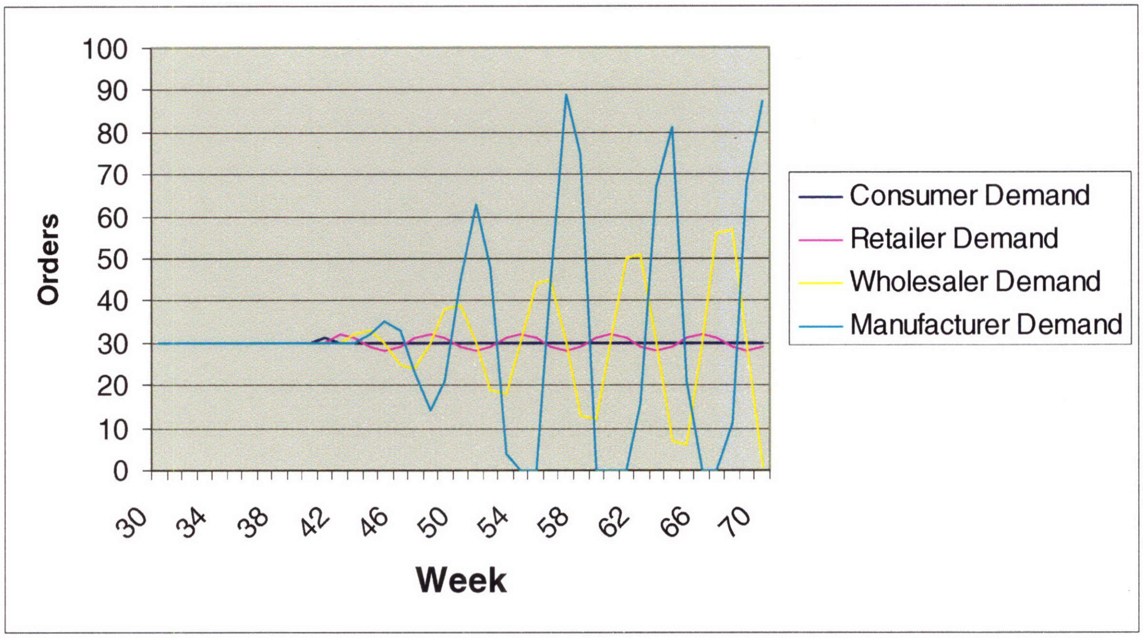
When customers order forward, they are expecting to receive product in 3 weeks. The mechanics of the model reflect forward ordering by creating additional desired orders at the manufacturer level first, then the wholesaler level, then the retailer level. When forward orders reach the retailer level, it is assumed that customers pick up the product immediately, and it does not sit in the retailer's inventory. It is also assumed that a product must flow through the supply chain like all other products, and cannot be routed around the supply chain from manufacturer directly to the consumer. With a forward order, the retailer notifies the manufacturer at the time the order is placed. The manufacturer immediately increases his desired order rate by one unit. The wholesaler waits one week, then increases his desired order rate by one unit. The retailer waits two weeks, then increases his desired order rate by one unit. If there are stockouts at any level, the order is interrupted.

4.5 Data

Baseline demand for experiments will be thirty units per week. That is, thirty units will be demanded by consumers every week, and the retailer will deliver thirty units and order thirty units for replenishment. The wholesaler and manufacturer, in the baseline scenario, will follow suit. Sensitivity analysis will be conducted by running scenarios with variances from this baseline. If consumer demand remains constant at 30 units, orders remain constant, and there is no volatility in demand anywhere in the supply chain.

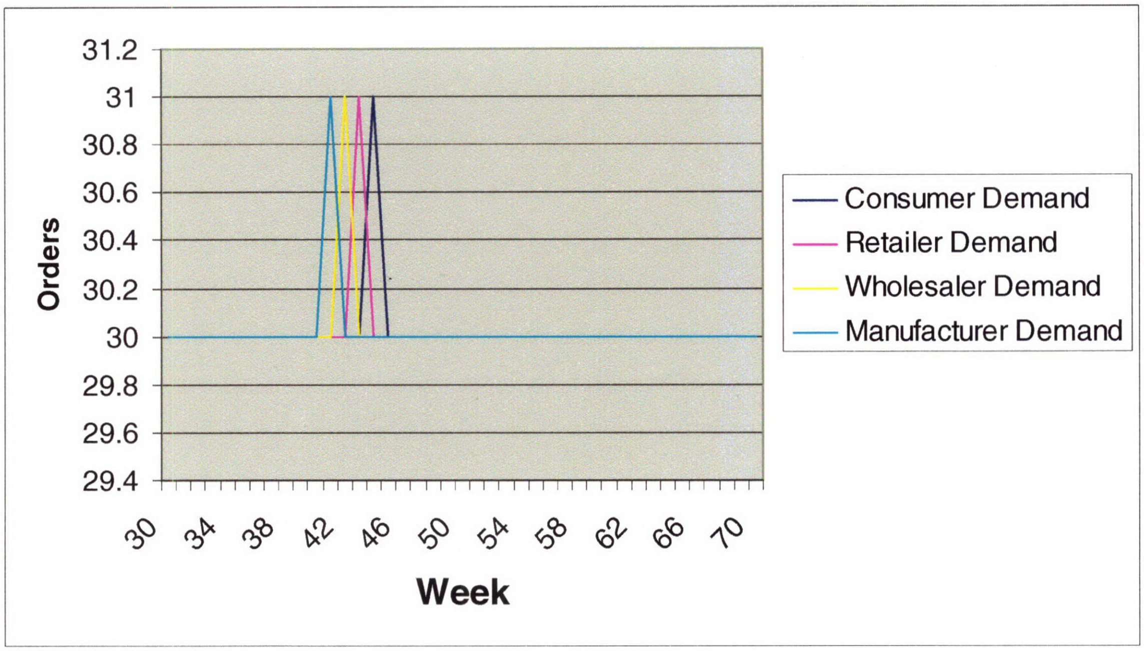
The first set of data is produced by a run in the simulation model reflecting a "pulse" of increased conventional demand. Demand is kept constant for 40 weeks, and then increased 1 unit at week 41. The retailer will deliver 31 units, and then order 32.33 units; 31 to replenish the original order, 1 to account for its new forecast of 31 for the following week, and .33 units to account for the 10% "overcompensation" between the demand from week 40 and week 41. Figure 4-3 shows demand at four different levels of the supply chain over time. In week 41, there is an increase in consumer demand of one unit.

Figure 4-3: Conventional Orders—1 Unit Pulse at Week 41



It is apparent from Figure 4-3 that a very small change in demand results in an oscillation in orders at the retailer, wholesaler, and manufacturer levels. Based on the parameters of the model, the retailer demand begins to oscillate at a steady rate into perpetuity. The wholesaler and retailer, however, have increasing oscillation as time goes on. We find that a constant oscillation at the retail level causes *increased* oscillation at the wholesale level. Therefore, a one-time increase in demand from a downstream tier will cause a steady oscillation one tier upstream, and any steady oscillation from a downstream tier will cause increasing oscillation one tier upstream. In contrast, Figure 4-4 represents demand at the same four tiers of the supply chain if a consumer orders the additional unit four weeks forward.

Figure 4-4: Forward Orders—1 Unit Pulse at Week 41



In Figure 4-4, we see the effect on system-wide demand if consumer demand increases by the same amount, but is purchased forward. Instead of the demand flowing conventionally upstream in the supply chain, a consumer buys the product forward and is willing to wait four weeks to receive it. No oscillation occurs, and the additional product is "pushed" down the supply chain instead of "pulled" by conventional information lags. In the model, when the consumer buys the product forward, the manufacturer immediately "orders" the product (or begins the manufacturing process), which takes a week to complete. At the beginning of week 2, the wholesaler orders one extra unit from the manufacturer, which takes a week to arrive. At the beginning of week 3, the retailer orders the product, which takes a week to arrive. The product is thus available for the consumer to pick up from the retailer immediately (at the end of week 3), or is available for shipment to the consumer. Figure 4-4 represents a case in which the consumer is willing to wait four weeks (i.e., one additional week for shipment from the retailer to the consumer). In a 3-week forward contract, the retailer would receive the product, and it would be immediately available for the consumer to pick up in the store. The consumer demand line in Figure 4-4 may overlap the retailer demand line in this case.

Figure 4-5: 1 Unit Pulse at Week 41—50% Conventional Orders/50% Forward Orders

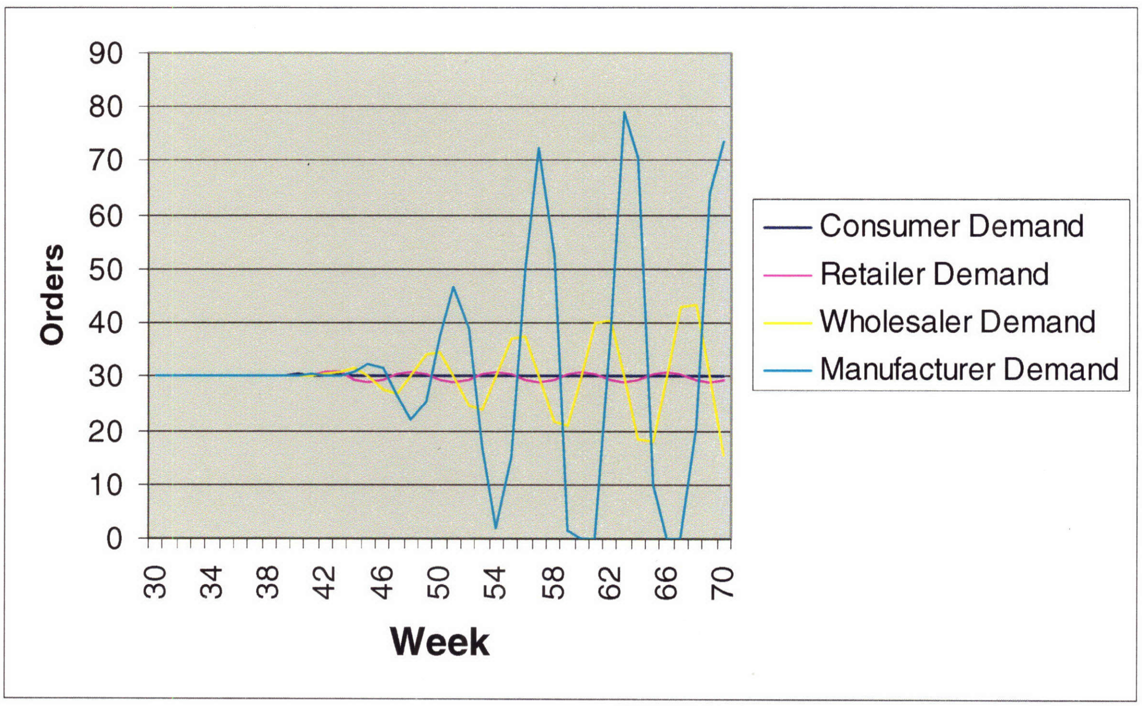


Figure 4-5 represents the same fluctuation in consumer demand, but half the variance is in conventional orders (.5 units), and half the variance is in forward orders (.5 units). The purpose of this test is to see the difference in the system-wide oscillation between one unit of conventional consumer demand variance (Figure 4-3) and a 50%/50% mix of the same variance. The effect is that the oscillation of demand at every tier is decreased 50%. The following figures show the effects in comparison:

Figure 4-6: Retailer Demand—1 Unit Pulse at Week 41

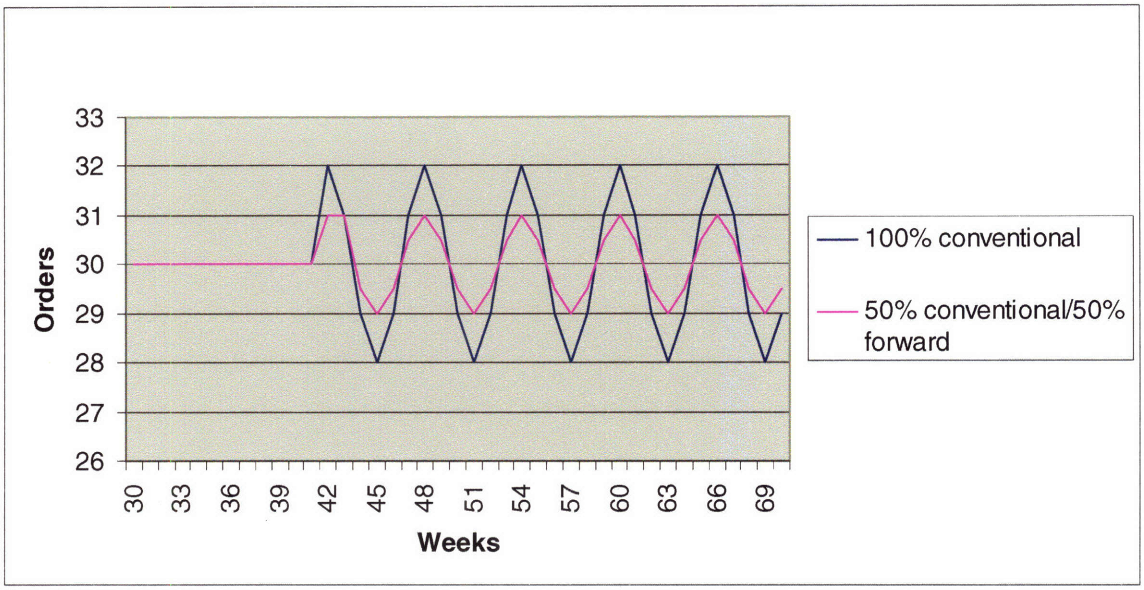


Figure 4-6 isolates retailer demand, contrasting the difference between 100% of the additional unit of demand being purchased conventionally, and a case where 50% of the additional demand is purchased conventionally and 50% of the additional demand is purchased forward. Figures 4-7 and 4-8 isolate the same comparison for the wholesaler and manufacturer, respectively.

Figure 4-7: Wholesaler Demand—1 Unit Pulse at Week 41

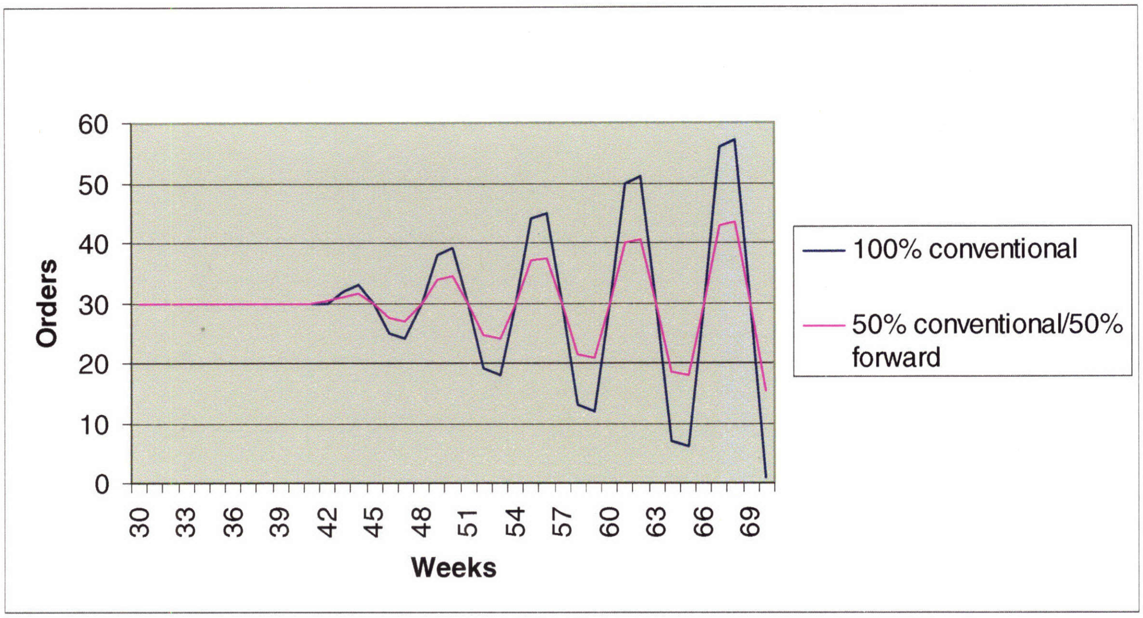
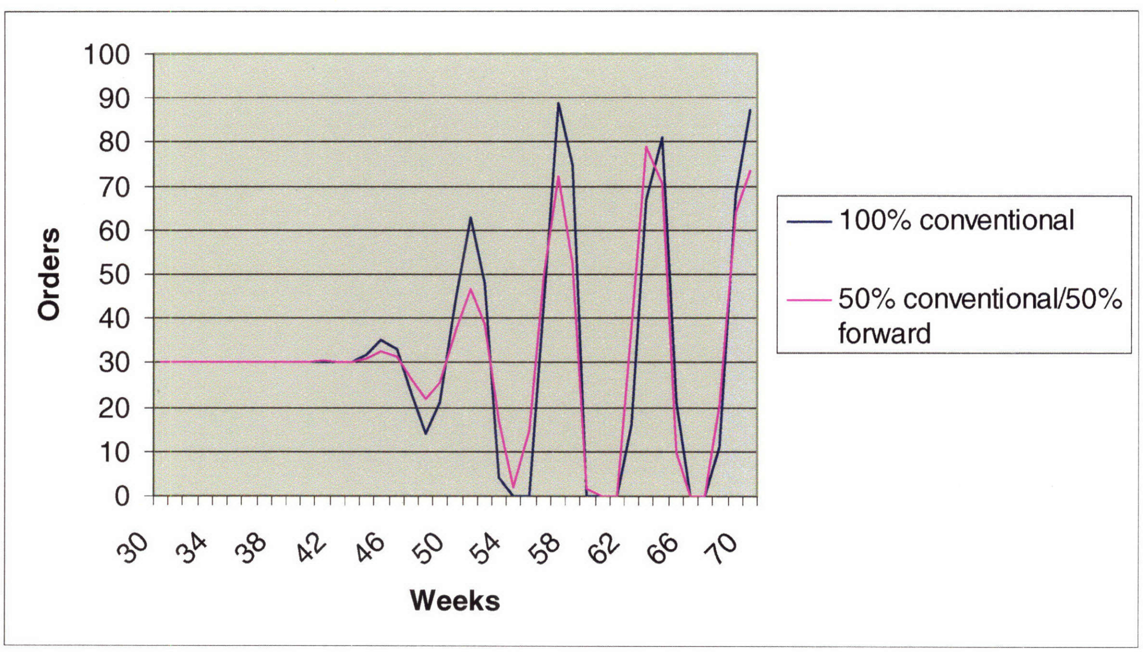
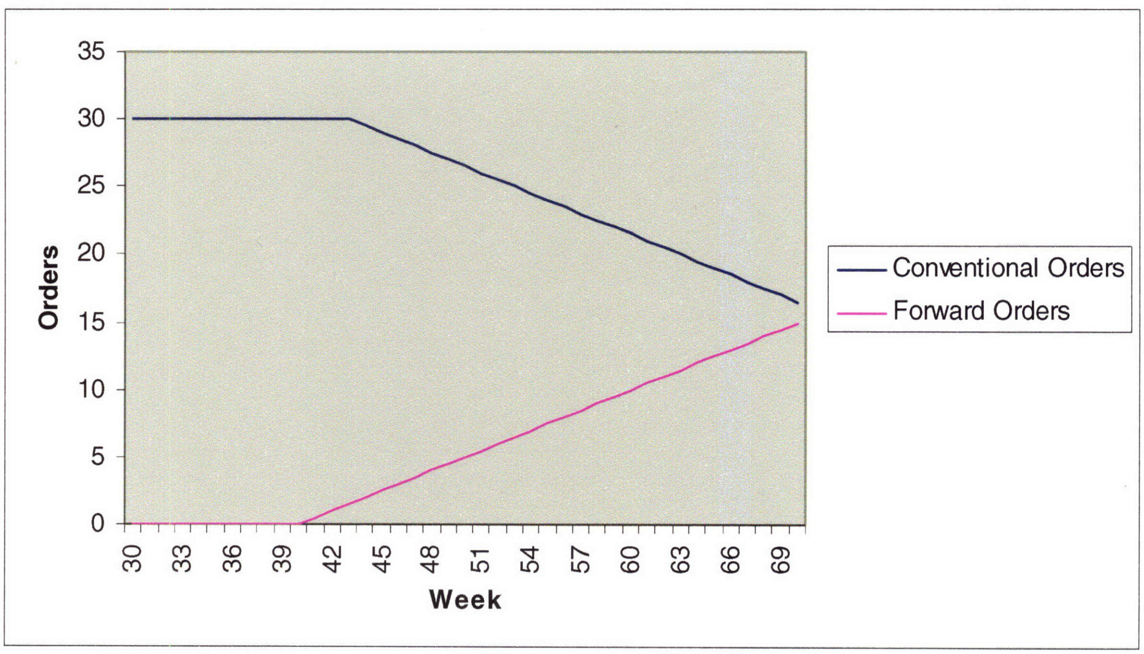


Figure 4-8: Manufacturer Demand—1 Unit Pulse at Week 41



If forward buying benefits every level of the supply chain, then who has the incentive to act? What does the implementation of a forward buying program look like? In the next example, consumer demand is constant at 30 units per week, but over time, conventional orders are *replaced* by forward orders. More specifically, conventional consumer orders decrease at a rate of .5 per week, beginning in week 43, and forward consumer orders increase at a rate of .5 per week, beginning in week 40. (The reason for the differential in the beginning weeks is that we are trying to keep demand for consumer *delivery* constant.) Figure 4-9 shows the mix of conventional demand and forward demand, with the total demand remaining constant.

Figure 4-9: Consumer Orders—Gradual Shift from Conventional to Forward Orders



This analysis helps to highlight the affect on order variability when conventional orders are *replaced* by forward orders. In the previous analyses, we showed the affect on ordering volatility when *additional* orders were made by consumers purchasing forward. Figure 4-10 shows the volatility created by replacing conventional orders with forward orders. There is a significant amount of volatility, which I did not expect. This volatility occurs because there is a disruption in the retailer's orders, and any disruption begins a bullwhip effect throughout the system. Even though the manufacturer's orders are "ahead" of the retailer's orders, and the manufacturer is able to anticipate orders in the future, any shift in the retailer's orders flow through the system creates volatility. Figure 4-11 shows the same scenario, but with conventional orders decreasing at a rate of .25 units per week (instead of .5) and forward orders increasing at a rate of .25 units per week (instead of .5). As expected, the same volatility occurs, but takes effect more slowly.

Figure 4-10: Constant Consumer Demand--.5 Unit Decrease/Week in Conventional Orders and .5 Unit Increase/Week in Forward Orders

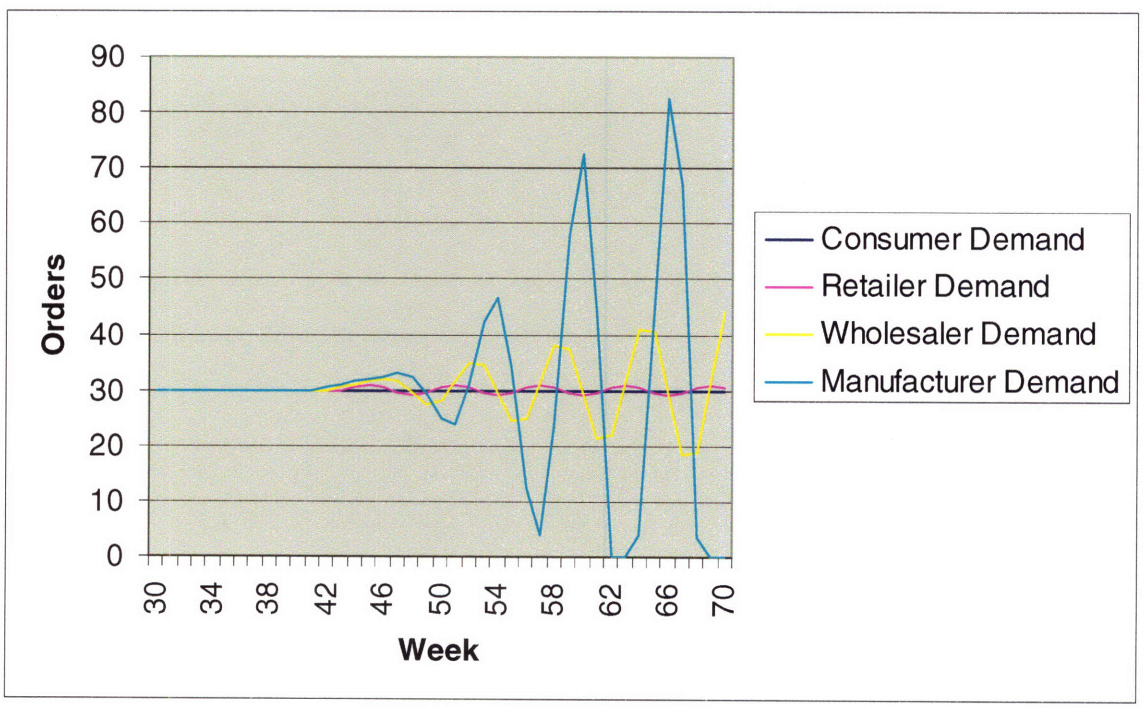
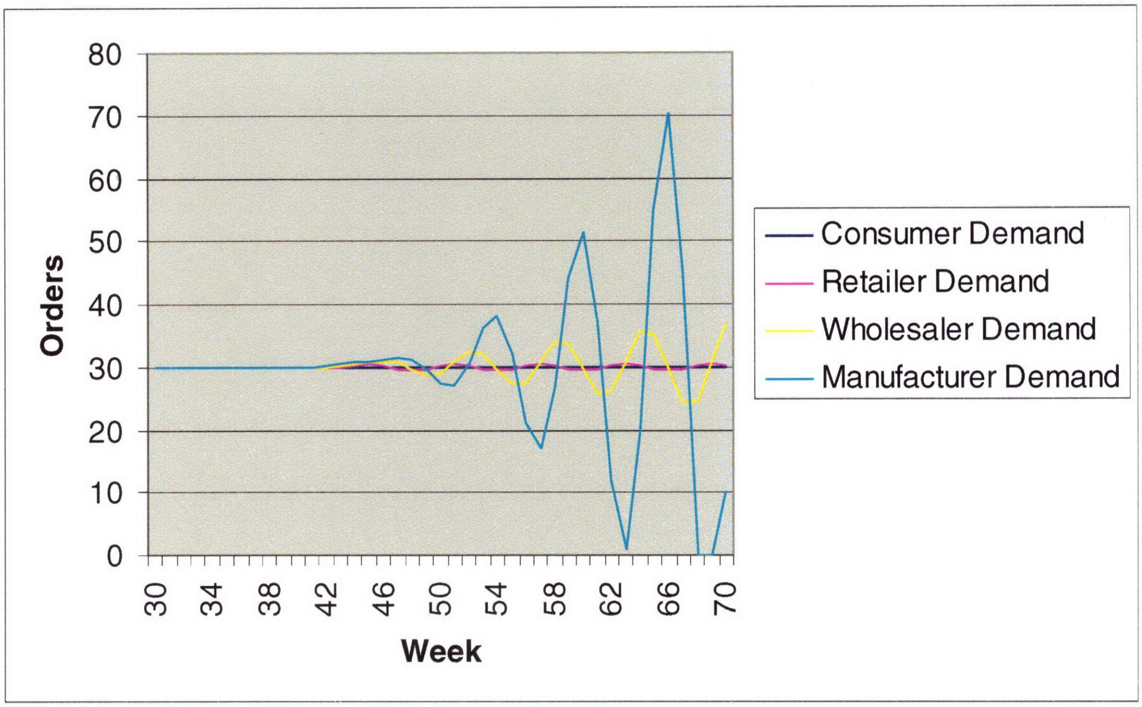


Figure 4-11: Constant Consumer Demand--.25 Unit Decrease/Week in Conventional Orders and .25 Unit Increase/Week in Forward Orders



In summary, the following table lists the characteristics and results of each simulation.

Simulation	Characteristics	Figure	Results
1	Constant demand for 40 weeks, then 1 additional unit of *conventional* demand in week 41.	4-3	Bullwhip effect is apparent; steady oscillation at the retail level, increased oscillation at the wholesale and manufacturer level.
2	Constant demand for 40 weeks, then 1 additional unit of *forward* demand in week 41.	4-4	In contrast with simulation 1, system oscillation is completely eliminated.
3	Constant demand for 40 weeks, then .5 units of additional conventional demand, and .5 units of additional forward demand in week 41.	4-5	In contrast with simulation 1, system oscillation is reduced by half; stockouts at the manufacturer level occur later.
1 and 3	Retailer demand is isolated from simulations 1 and 3.	4-6	It is easier to see the amplitude of the oscillation for retailer demand. Retailer demand oscillates half as much when 50% of additional demand is purchased forward.
1 and 3	Wholesaler demand is isolated from simulations 1 and 3.	4-7	It is easier to see the amplitude of the oscillation for wholesaler demand. It oscillates half as much when 50% of additional demand is purchased forward.
1 and 3	Manufacturer demand is isolated from simulations 1 and 3.	4-8	It is easier to see the amplitude of the oscillation for manufacturer demand. Stockouts occur, and the benefits of forward buying are significantly reduced.
4	Instead of additional consumer demand in the system, conventional demand is *replaced* by forward demand at a rate of .5 units/week.	4-9	The figure shows the reduction in conventional orders and the increase in forward orders.
		4-10	The figure shows oscillation of demand for each tier, for the purpose of contrast with simulation 1. There is little difference, and oscillation is significant.
5	Instead of additional consumer demand in the system, conventional demand is *replaced* by forward demand at a rate of .25 units/week.	4-11	The figure shows oscillation of demand for each tier, for the purpose of contrast with simulation 4. The oscillation is half as severe as when demand is replaced at .5 units/week.

The purpose of the simulations was to contrast the differences in demand volatility in the following scenarios:

- additional demand ordered conventionally
- additional demand ordered forward
- the replacement of conventional demand with forward demand

It is apparent that forward buying benefits systems when there is additional demand versus a system where conventional demand is replaced by forward demand (Figures 4-5 and 4-10). Furthermore, when stockouts occur, forward ordering has little benefit for the corresponding tier in the future (Figure 4-8). However, other tiers appear to be unaffected (Figures 4-6 and 4-7). Finally, a system that is designed *for forward orders only* has no volatility in demand (Figure 4-4).

Like any attempt to model a complex system, several variables that would be fluid and dynamic must remain constant in order to see sensitivities. If orders increased from 30 to 31 one week, and then returned to 30 in perpetuity, the system would most likely take notice and return to normal ordering levels. For this reason, it would be inappropriate to attempt to quantify the benefits of forward buying using the data in this thesis. There are, however, several conceptual insights to be gained from this exercise. The most notable insights are:

- Forward orders are only beneficial to a system if there is good communication between tiers,

- Forward buying, if implemented properly, is most beneficial to those tiers furthest away from the consumer,
- Retailers have the least incentive to process forward orders, or provide discounts to consumers for doing so,
- Forward orders help a system the most if they are *additional* orders to "normal" volume. If they replace orders, demand of downstream participants such as retailers can be interrupted, resulting in increased volatility.
- Once stockouts begin to occur at a given tier, forward buying has little benefit at all to that tier.

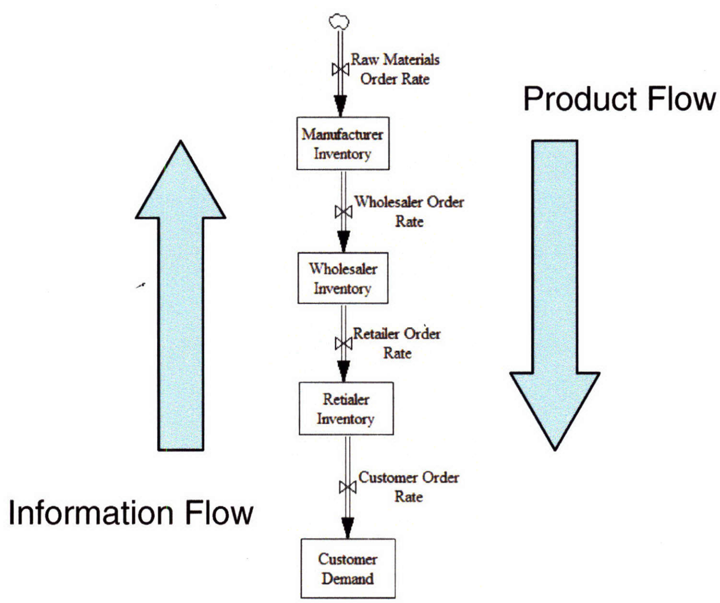
5 Conclusion

Before conducting any analysis or exploring the reasons wineries offer futures to consumers, I believed there was value in a mechanism for the forward purchase of non-commodity consumer products. I hypothesized that markets for consumer products would be more efficient if they had a mechanism for trading future capacity similar to commodities that served the end-user.

After conducting my research, I found that wine futures were not used as a tool for mitigating quality risk or risk of future demand. They are simply used as a financing tool, or an asset-backed loan for the winery. Furthermore, the supply for high-quality wine may be constricted enough that it always demands a premium, and the premium it demands is almost exclusively a function of its quality. That is, whether 1,000 bottles of a high-quality wine is produced, or 20,000 bottles, the price for which it eventually sells is almost exclusively a function of its quality, and is not how much of that specific wine is available. Thus, the supply curve for high-quality wine may not vertical, but may be horizontal, so wineries produce as much high-quality wine as they can. Also, due to advances in technology, the quality of wine two years before it is bottled is no longer a mystery, and futures for wine is a relic of when quality used to be uncertain. Wine futures, therefore, are different than futures for non-commodity goods about which this thesis hypothesizes, since there is no risk of obsolescence and very little risk of forecast error.

For a generic supply chain for non-commodity goods, data from the model in this thesis suggests that there is little incentive for retailers to market products for future delivery. Wholesalers and retailers, who may benefit more from forward information, do not have a business model that engages end users, and therefore may have difficulty engaging consumers. Also, the data suggests that forward purchases only benefit the supply chain from an inventory and order management standpoint if they are orders exclusive to the normal demand of conventional orders. That is, if forward orders replace conventional orders, they may have a negative effect by disturbing the supply chain. Supply chains for consumer products are often built with information flowing upstream and product moving downstream, as shown in Figure 5-1.

Figure 5-1: Information Flow and Product Flow



One of the main purposes of a conventional supply chain such as this is to manage upstream information flow. Even if wholesalers and retailers benefited from forward orders, to what extent would their services no longer be needed? If manufacturers received forward order information, wholesalers may be bypassed completely, and retailers may begin to lose margins due to discounts on products. Manufacturers (or final assemblers of products) may ship directly to consumers, and use Dell's model, for example.

The data suggests that a supply chain that engages in forward ordering by consumers may be the most appropriate for a manufacturer to consumer model. Dell, who is the final assembler of personal computers, benefits from selling computers a week or two forward. It can assemble the computers after the order arrives, and thus holds very little inventory.

If Dell had to make orders from its suppliers for component parts months in advance, selling computers a few months forward may justify a discount for increased time to delivery. If Dell's suppliers can supply it on a daily basis, there is likely little or no benefit for selling computers forward for more than the time it takes to assemble and deliver the product. The key point is that forcing forward buying into a supply chain for which it not designed may have little or no benefit, but it may benefit future business models for consumer goods where times for assembly, shipping, and order fulfillment are unusually long.

5-1 Future Research

Futures and forward contracts discussed in this thesis are one type of derivative. Other types, like call and put options, may also present value to a supply chain. In an interview with a former Chief Operating Officer of a light manufacturing company in the southeast United States, I learned that selling forward contracts to customers would have been extraordinarily valuable from the standpoint of inventory management. The COO (Interview, May 26, 2007) also said that, in the absence of a forward market, owning call options for materials upstream would have done the same job.

The company sold reflective belts to the military, who demanded delivery within five days. Orders from the military came in intermittently, usually just before a deployment, and the lead time for ordering materials required to make the belts from 3M usually took about a week. Once the reflective material was received on a roll, the assembly and manufacture of a typical order (between 5,000 and 30,000 units) took no longer than two days. The COO claimed the only way to succeed in the market was by having the ability to get the product to the customer within the five-day delivery requirement, and the military would not deal with companies who were unable to do so. His company, therefore, was forced to carry $150,000 worth of safety stock to cover potential orders, and had no idea "what the future mode or mean of orders would be (Interview, May 26, 2007)."

"If the military used forward contracts, we could reduce inventory to simply work-in-progress, or about $50,000 worth. At times between orders, we would have to carry almost nothing. At a weighted average cost of capital of 12%, and considering we could use the space for storing other inventory, we would be able to offer a pretty substantial discount. On the flip side, if we could buy a call option [or, the right but not the obligation to buy product] for two-day delivery from 3M, it would have the same effect. 3M supplies a number of customers with the same reflective product, and I imagine it would be more cost effective for them to hold the inventory we otherwise have to hold. We could offer the same discount, and it would reduce a lot of headaches (Interview, May 26, 2007)."

Therefore, upstream call options may have the same effect as downstream forwards. However, the COO's company differentiates itself by holding the inventory, and if 3M offered call options, or if the military were willing to indicate its demand further into the future, the company may lose its competitive advantage of storing reflective tape for quick turnaround service. It can be assumed, therefore, that offering derivatives such as forwards and call options into non-commodity markets would reshape the competitive landscape of business. Supply chains may have to be redesigned to take full advantage of upstream information, and companies may have to change their strategies.

In conclusion, forward contracts and other derivatives may have a place in non-commodity markets, but most likely would only be valuable to supply chains that redesign themselves to handle them. The data from the model in this thesis suggests that those firms in direct contact with the customer have the least to gain, and firms further upstream that have the most to gain may be destroying their competitive advantage.

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7 Appendix

APPENDIX: System Dynamics Model